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MEDICAL HAEMORRHAGE SURGICALLY TREATED,

With a Successful Case, by a New Technique,

OF

SALINE INFUSION FOR SEVERE HAEMORRHAGE.

BY

ROBERT H. M. DAWBARN, M. D.,

PROFESSOR OF OPERATIVE SURGERY AND SURGICAL ANATOMY,

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"Friendship's blind service in the hour of need,
Wipes the pale face and lets the victim bleed.
Science must stop to reason and explain;
Art claps his finger on the streaming vein!"

Thus sings our sweetest singer. But what shall Art do when that vein is out of safe reach of his finger? What, in cases of apoplexy, hæmoptysis, wounds of the lung, hæmetemesis? Who is there that feels even a moderate amount of satisfaction with our success in checking bleeding where the broken vessel is not amenable to direct pressure or the artery-clamp?

The drugs we use—some of us—are legion. They range from ergot to gallic acid; from turpentine to lead; and yet we have a very strong feeling that our efforts along this line are commonly of little avail, and that other and natural causes, mainly, effect the cure if bleeding ceases.

The very fact that the list of remedies at our command, and recommended by standard authorities as of

* Read at a meeting of the Surgical Section of the New York Academy of Medicine, held Nov., 9th, 1891. Also read, in major part, at the annual meeting of the Orange Co., Medical Society of New York.

some use, is so long a one, of itself goes to show their inefficacy.

Dr. Loomis' opinion in a matter of bleeding from the lungs is one which would be, I think, accepted with respect. His "Text book of Practical Medicine," eighth edition, p. 95, says, "It has never seemed to me that styptics or astringents have any control over bronchial hæmorrhages, but aconite and opium are the two remedies upon which I rely. When the pulse is full and strong, I use aconite; when it is weak, I employ morphia hypodermatically."

The really valuable means, concerning which the present paper is in part to treat, Dr. Loomis does not even mention. As to aconite, so far as it is of use at all, it is by bleeding the patient into his own veins, so to speak; and has hence been called the "vegetable lancet." This idea in a much more efficient form, is just what I propose to advocate. Regarding morphine, by slowing the breathing it renders the pulmonary circulation rather less active; and it also causes mental quietude and calm. But that is all. After a time nature causes a coagulum at the mouth of the bleeding vessel; and to aid this, our drugs do very little.

During eight to ten years past, I have, for purely logical reasons, been urging upon my students a different line of treatment in these cases—cases, I mean, of dangerous and yet unreachable bleeding anywhere.

This plan is, simply to collect a great portion of the blood elsewhere than at the bleeding point until time has been given for a firm clot to form—say an hour or so—and then slowly allow it to re-enter the general circulation.

It is plain that this sequestration, especially if carried to the point of causing a feeling of faintness,

must diminish the blood-pressure at the bleeding point, and thus conduce to clotting.

The experience which has been gained by actual practice of this plan during these years has added to my confidence in what seems almost a self-evident proposition. The plan is nothing new, I need hardly say; but devised in a day when, as to scientific knowledge regarding the circulation, the margin was wider than the text thereof, it seems not to have appealed strongly to the common sense of the fathers in medicine. So far as I can discover, it was not vigorously and faithfully tried, and was allowed to lapse. Instead, in those days, bleeding was done to check bleeding. For instance, it was at one time standard in hæmorrhage from a wounded lung (in addition to tamponnage) to bleed to faintness. The idea is similar, of course, to that now under discussion, and is perfectly sound in theory; only, the patient would presently need that lost blood to avoid dangerous shock and to aid recuperation of strength. A *temporary* bleeding into his own veins, so to speak, would have been wiser.

Herein the Spanish windlass is our friend. That is, a towel or hankerchief is knotted loosely around one limb (or if need be the same method on all four limbs) at the junction with the body; and by twisting this with a stick, blood is prevented returning to the trunk. In consequence, the limb swells visibly. The *arterial* circulation is not so easily shut off; nor, of course, do we wish it to be. Hence, we avoid stopping the pulse on the distal side of our windlass.

That such local stagnation of circulation is not free from danger in careless hands, is granted. The limbs should be watched and kept well warmed; the constriction should not too long be maintained, lest gangrene

result. This, like other serious measures in medicine, is to be advised simply as the lesser evil, and when death threatens from a severe hæmorrhage not otherwise controllable.

There are certain persons born with what Oliver Wendell Holmes calls a "squinting brain." The proposition that the sum of seven and five is twelve they regard with suspicion. To them, it seems eleven. Once in a while, by trying and proving everything, and taking nothing at all for granted, they really do upset some alleged fact upon which men have builded. Then their seven and five becomes that "little leaven which leaveneth the whole lump."

Such a doubting Thomas surprised me a few months ago, when I was discussing these matters with him. I had been speculating upon the possible outcome, had the greatest pulpit orator of this age, when stricken with apoplexy, been promptly Spanish-windlassed; instead of being treated after the sugar-pellet method. I thought it quite possible not only that death might have been averted, but that a small brain-clot instead of a huge one might have resulted; and the patient, surviving his slight but partial stroke, might have given the world a further period of brilliant work.

Here the gentleman with the mental squint observed, that he hardly thought so. Indeed, upon reflection, he thought the plan suggested would be harmful. For, by diminishing, as it would do, the amount of blood in the brain-vessels (by collecting it elsewhere in the body), the pressure outside those vessels would be lessened. Hence there would be less resistance, within the skull-cavity, to a big clot forming than otherwise would be the case. He thought, therefore, that

hereafter he would have his apoplectic patients at once placed with the *head lower than the trunk;* for the quicker the head filled with blood, distending its vessels, the less space there would be for a clot to form in the brain outside them; and hence the more resistance to the outflow from the broken artery which would cause that clot!

In order to settle the point thus raised, I wrote to Dr. William Gilman Thompson, who is very good-natured, a classmate of mine, and Professor of Physiology in the University of New York. Dr. Thompson's reply I will read you, by his permission:

March 18, 1891.

My Dear Dawbarn:

I am much interested in your discussion regarding apoplexy, for I have recently been repeating some experiments upon intracranial pressure which I first saw in the Hoagland Laboratory a year or more ago.

I. The normal blood-pressure in a dog's carotid supports a column of water about 7½ or 8 feet high. If the dog's skull be trephined, and a cork perforated by a small glass tube be carefully fitted into the trephined opening, water-pressure may be applied to any desired extent through the tube, over the surface of the brain. No effects are noticed until such pressure becomes greater than the carotid pressure; *i. e.*, greater than eight feet of water. When this limit is passed, the animal has convulsions, at first unilateral, affecting the legs of the side opposite the tube—then becoming general, until death is imminent from spasm of the diaphragm.

Reducing the pressure is followed by immediate relief. By raising and lowering the pressure-bottle, convulsions may be produced and controlled *ad lib.*

Remove the cork, and for several minutes the cortical vessels appear excessively anæmic. Then follows intense congestion, so great as to cause considerable hernia of the brain through the opening. It would be interesting indeed to apply windlasses in various situations, and note the effect while the above experiments were being performed.

II. *Strapping the large veins in the extremities to prevent venous*

*return, during pulmonary hæmorrhage, has undoubted and immediate effect in lessening that hæmorrhage. I have often verified this.**

III. Such procedure would doubtless tend to lessen extra-vascular cerebral pressure, but it would simultaneously lessen the intra-vascular pressure; and the latter would be affected to a greater degree, and more promptly, I should think, tending to give the hæmorrhagic blood time to clot.

The reason for this would be that the extra-vascular pressure would be dependent somewhat upon conditions of absorption and osmosis; which would act more slowly than the almost instantaneous effect of withdrawing blood from the heart, by damming it back in the extremities.

Even ligating the carotids or the vertebral arteries has no very decided effect upon the quantity (and hence the pressure) of the ventricular fluid, or the amount of fluid contained in any of the cerebral tissues; while, of course, the pulsations of the brain cease, and the intra-vascular cerebral pressure falls.

I should think, in conclusion, decidedly, that the very worst thing we could do in a case of apoplexy would be to increase, in any manner, the intra-vascular pressure.

Sincerly yours,

W. Gilman Thompson.

Such testimony as this, no man can ignore.

I do not say that we should utterly discard the use of drugs in such cases; but would formulate my position in this wise:—Whenever there is bleeding acute enough to threaten life, and not within reach of direct pressure nor of the artery-clamp, our main reliance should be the tourniquet or the windlass, generally placed upon all the limbs.

I need hardly say that promptitude and the ounce of prevention may here save a pound of blood. Given a case where bleeding from the lungs or stomach has already occurred; or given a patient where family history, high living, and attacks of cerebral congestion (perhaps with one or two slight strokes already

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* Italics mine. R. H. M. D.

sustained) point to apoplexy as the probable end of the story, we should make it a rule to show the relatives, privately, how to make and use the windlass. As to apoplexy, we should say to them : "If ever Mr. A. becomes suddenly unconscious, then, unless his face is pale and his pulse weak, put on the windlasses instantly, tight enough to make the limbs swell. Do this even before you send for the nearest doctor. Do not leave these bands on longer than an hour."

As a matter of collateral interest, I may remark that in pulmonary œdema suddenly developed by cardiac exhaustion from any cause, the windlass on the extremities offers, I believe, our speediest means of relief to the tired heart, tiding over a critical period, until by free stimulation this organ can be made to resume efficient work. Valuable as is cupping, in pulmonary œdema, the windlass is much more so, and for reasons which are obvious, upon reflection.

In the remainder of this paper, let us discuss briefly the question of saline infusion as a supportive means after checking an alarming hæmorrhage.

I firmly believe that many a life is now lost in private practice because after severe post-partum or other bleeding has been controlled, the family doctor has not the nerve, or the experience, or the appliances thought necessary to accomplish infusion; and the remaining amount of circulating medium being not enough, the patient succumbs.

And I have an abiding hope and trust that a plan of which I am about to speak—an exceedingly simple plan—may be the means of so popularizing saline infusion that it will be used wherever a sharp bleeding has occurred; even though life be not actually imperilled thereby.

But first it may be well to remark, that the day of transfusion, (either mediate or immediate) as distinguished from infusion, is past. That is to say, we now know that as good if not better results are reached by injecting warm saline-alkaline water as by transfusing blood. Aside from the obvious dangers—clotting, with embolism, sepsis, etc.,—attendant upon the use of any kind of blood, we now know that blood-cells other than human are broken down and disintegrated almost at once within the human body; and, in consequence, a great mass of detritus is thrown upon the organs having charge of metabolism of tissue, threatening to overwhelm them with work. Even human blood-cells are probably always so destroyed, although more slowly, when transferred into another body than that which gave them birth.

What seems needed is only some unirritating fluid, supplying the lacking volume within the heart and vessels. That is, to give to the heart a sufficient bulk of some harmeless current running through its chambers to excite systolic action. If this is done, and done promptly, before the patient suffers too much from the shock caused by sudden and extreme anæmia, it is wonderful how large a loss of blood may be survived; and how rapidly, as if by magic, Nature supplies multitudes of new red blood-cells to replace those lost.

As emphasing these points, the following quotation from an eminent authority, will be of interest.*

"After the greatest losses of blood in animals, a sufficient number of red corpuscles always remains in the circulation to carry on respiration, provided that the circulation is maintained. In

* William Hunter. Third lecture on Transfusion; delivered at the Royal College of Surgeons. From British Medical Journal. Aug. 10, 1889; p. 309.

animals, after the loss of half or two thirds of the total quantity of blood in the body, the number of corpuscles per cubic millimetre may be found as high as 3,000,000 or 4,000,000. The absolute loss is great, but the relative loss is slight and is of little importance. The animal's health is in no way affected injuriously by the loss. * * * * In man, the loss of blood can never be so great as in animals. Syncope occurs earlier. Transfusion of blood, is therefore, never required for the purpose of supplying red corpuscles to carry on respiration after sudden loss of blood in a patient previously healthy. The immediate source of danger in such cases is not the want of red corpuscles, but the disturbance of the relation between the vascular system and its contents. * * * * It is remarkable how slight the disturbance in respiration may be in cases, for example, of pernicious anæmia in which the red corpuscles may be reduced to ten per cent., or even less, of their original number. I have observed cases in which the number of corpuscles was as low as 500,000 or 600,000 per cubic millimetre, instead of 5,000,000, as in health; the respirations never rising above 20 per minute, the breathing, during quietude, being perfectly tranquil throughout."

Of course, if one had abundant time in which to prepare, the best saline-alkaline fluid would be one identical in its components and their proportionate quantities, with those found in blood-serum. Most surgical text-books give a formula more or less approaching this, though simpler. Of late it has been recommended by Ludwig, of Leipsic, to add to our saline-alkaline water, a little sugar; this being a natural ingredient of blood.

Simplest of all, and so far as we can see, practically about as good as the most complicated of these formulæ, is warm water plus a little table-salt. It has the great advantage, too, of being always easily obtainable when wanted. The best proportion of salt is 6 in 1000 parts; or about that in blood-serum. This would be, roughly, a heaped teaspoonful to a quart of warm water. The water should first be boiled, for aseptic reasons.

We must never forget the salt. Such an omission would be fatal. Pure water, devoid of sodium chloride, when injected in any considerable amount, will at once dissolve out of the blood-cells their hæmoglobin, and thus promptly kill the patient.

Now for the new and simple technique to which I alluded a few minutes ago.

It involves no cutting whatever, no searching for a collapsed vein, no freshened knowledge of anatomy, no tying in of a cannula, no cannula at all, in fact.

All the appliances needed are such as to be right at hand (it can be reasonably assumed) in nearly every instance. The solution has already been spoken of. The instruments are :

An ordinary Davidson's syringe.

An ordinary soft rubber catheter, or a small rubber drainage-tube.

An ordinary hypodermic needle—large size preferred, though this is not essential.

Even if our patient is pulseless at the wrist, we can almost to a certainty feel the femoral beating just below Poupart's ligament. Now take the needle—not as yet attached to the catheter—and push it directly into this artery, going slowly, until bright-red blood is seen to well up from within the needle. (As the artery here is large enough to carry a lead-pencil, the needle will not easily miss it, with a little care.)

As soon as the arterial blood is seen in the needle, slip over its base the catheter—already attached to the syringe, the nozzle of which has entered it at the eye, and both being filled with the warm salt-water—and tie a thread tightly about the catheter, securing it to the base of the needle.

Now, holding the needle in place firmly and

steadily, pump the fluid directly into the arterial current. To avoid possible pumping of air by an old or leaky syringe, make an abundance of the salt-water, and keep the entire syringe, with the hand working it, beneath the surface.*

That is the whole story; and how very simple, how very easy! A Davidson syringe is to be had in almost every home. Every doctor carries, or should carry if out of the city, a soft catheter and a hypodermatic syringe. From the moment the determination to use saline infusion is reached, until the moment that infusion is actually entering the blood-current need not average five minutes.

If men prefer a simple to a comparatively complicated thing, otherwise of equal merit, then will they, I must believe, prefer this method to a cutting operation, with searching for a small and collapsed vein, tying in of a cannula, etc.

Should it be objected that this plan injures a very important artery, I would reply, that this is decidedly a lesser evil of those which confront the patient dying from loss of circulating-fluid.† Furthermore, I have used this plan upon the human subject, saving the patient's life—as will presently be detailed to you—

* It is hardly necessary, perhaps, to remark that an assistant's fingers pinching the tube during emptying of the bulb will prevent regurgitation, if the valves leak.

† In this connection it is worthy of note, that a recent method of treating aneurism inoperable by pressure, ligation, or other usual plans, and advocated by McEwen, the Glasgow surgeon, is *needling*. Prof. J. A. Wyeth, of this city, operated upon an aneurism of the arch of the aorta by this plan at the Polyclinic hospital about a year ago. He inserted into the diseased vessel thirteen needles; with one of which he lightly scratched the oppo-

and with no subsequent annoyance whatever regarding the femoral artery.

A further advantage of this technique is the fact that thereby it is difficult to make the otherwise common error of throwing in the injection-fluid too fast, suddenly overwhelming the tired heart. Until one has tried it, one hardly realizes how much the intra-vascular pressure will obstruct the inward flow through the needle, even in a patient with a badly flagging heart. There will be so much resistance that it will seem as if the needle *must* be plugged with a clot or some other foreign body; so slowly, in spite of vigorous pumping does the stream pass in. And yet in the course of a half-hour of steady work a pint or more can be made to enter.

Reflecting that occasionally the Davidson syringe may not be promptly obtainable, I have experimented with this plan upon the dog, using gravity as a force, by means of a fountain-syringe. If the reservoir be elevated about six feet, it will succeed perfectly well. If much lower than this, the intra-vascular pressure may still be enough, after even a severe bleeding, actually to force the arterial blood *up* the needle and into the tube, instead of the reverse!

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site wall of the sac. All were left in place twelve hours. Ten days later, thirteen needles were again inserted, and again left in twelve hours. The same treatment was repeated a third time, after another ten days' interval.

Dr. Wyeth reports the result, at the present date, as favorable. The sac is distinctly smaller.

If a diseased arterial wall will safely bear such needling as this for twelve hours, and repeatedly, it would seem a fair inference that a sound artery may without serious hurt bear a single needle for a single half-hour.

Although during and after a considerable bleeding the arterial tone may be maintained, by reflex action, so as to equal or perhaps for a time exceed the normal blood-pressure, yet when the bleeding is carried to faintness, the diminished cardiac vigor would result in lowered pressure. Such loss of blood as would require saline infusion would in all likelihood be accompanied by faintness; and consequently, if the method by gravity be used, the reservoir need hardly be higher than the altitude needed to overcome the average pressure in the unbled femoral; which is, in man, about 120 millimetres of Hg. It is estimated that a pressure of 200 millimetres of Hg. may *possibly* be found in the unbled human carotid. For the lower, or average pressure just given, the equivalent in a capillary column of the normal salt-solution (6 in 1000) would be a height above the blood-vessel of 1.626 metre; or rather more than five feet. For the possible higher pressure named, 2.71 metres.

Let me here remark that I am indebted to Prof. John G. Curtis, of the College of Physicians and Surgeons, New York, for his interest in my work; who also in the following experiments, as well as many others, in different lines, made during the past Winter and Spring, kindly put his physiological laboratory and its appliances at my service.

On May 15th, 1891, I operated, Dr. F. J. Brockway assisting, on a dog weighing beforehand 10.4 kilos. (22.73 lb. avoir.); 300 cu. c. of blood being taken from the right common carotid. Thereafter his pulse could only be felt in the femoral. Then, with an ordinary hypodermatic needle inserted into the femoral artery, we injected the same amount of warm, normal salt-solution, using the technique just described. Instead of a

Davidson, a fountain-syringe was employed; the level of the fluid in the bag being 5 feet 4 1-2 inches above the artery. It required fifteen minutes for the 300 cu. c. to enter this dog's circulation.

If in dogs a rule which applies to humanity holds good, namely, that the quantity of blood equals about one-thirteenth of the bodily weight, then this dog had before bleeding about one and three-quarters lb. of blood. As 300 cu.c. (about ten ounces) were drawn, this would be proportionally equivalent to a loss (and subsequent replacement by other fluid) of nearly two quarts from a man weighing before bleeding 150 lb.

I have with me to-day for your inspection a very interesting kymographic tracing, by the mercurial manometer, taken from another dog upon whom I made a similar experiment, but for a somewhat different purpose. This was to test the effect of *extremely hot* saline infusion, as distinguished from the same fluid used at the temperature of the body.

Whoever has seen cases of cardiac failure upon the operating table, whether from anæsthetics or from other causes, knows that surgeons rely much for resuscitation upon the application of almost scalding-hot wet cloths over the heart. As in many such instances the patient is devoid of reflexes, being completely anæsthetized, I must believe that the undoubted stimulating effect of these applications is in such instances due to the direct extension of the heat until felt by the cardiac ganglia.

Whoever has noted the vigor with which unstriped muscle, everywhere, reacts to the use of heat—for example, the much stronger and decidedly more permanent uterine contractions which result from hot post-partal injections, as opposed to cold ones—must believe

it probable that such unstriped muscle, forming as it does a most important tunic of the blood-vessels, would be greately aided by *hot* saline infusion in regaining its lost tone. Perhaps, too, the central sympathetic centres would feel and respond to this stimulus.

Now, since a more vigorous cardiac action, accompanied by a somewhat restored vascular tone, would go far toward recovery, both from hæmorrhage and its attendant shock, I have felt that the experiment was well worth trying.

A priori it would seem safe to employ this salt-water as hot as the hand can possibly bear (which is about 49 C. (120 F.); since globulin only coagulates at 70 C.* (158 F.), and serum-albumin at 72 C.† (162 F.); or about 40 degrees F., hotter than the hand can support.

On May 15th, 1891, I operated ‡ on a large dog, weighing before bleeding 16.77 kilos. On the 1 in 13 hypothesis, his weight of blood would have been 1290 grammes, or (allowing for sp. gr. of blood) about 1222.75 cu. c. The cannula of the Hg. manometer was inserted into the right carotid. The right femoral was used for bleeding; the left femoral for injection of the hot salt-solution. Prof. Curtis superintended the working of the kymographic needle. Dr. F. J. Brockway assisted me. We drew 563 cu. c. of blood.

This was a tremendous loss—nearly equal to one-half the total amount the dog possessed. Now 250 cu.c. of the normal salt solution were slowly thrown in, at a temperature of 120 F. This was less than half the amount of blood lost; and yet the effect of its introduc-

* Kirke, 11th Edn. p. 846. † Dalton, 7th Edn. p. 80.

‡ In both this and all experiments on animals I have used morphine enough to prevent suffering.

tion upon the cardiac vigor, vascular contraction, or both, was striking in the extreme. As evidenced by the kymographic tracings herewith presented to you, the pulse seemed almost as powerful, for the time being, as before a drop of blood had been lost.

Subsequently a further bleeding of 470 cu. c. was permitted; now, the loss being one of blood mingled with salt-solution, of course. In attempting to replace this loss once more by hot saline injection, a mistake—a most interesting and instructive one—was made. Dr. Brockway and I each supposed that the other had added the salt to the hot water, for the fresh injection; whereas in fact, neither had done so. And within a minute after receiving a considerable amount of this plain water injection, the animal died.

On May 17th, 1891, I was given an opportunity to use in actual practice the points upon which I have dwelt in the last half of this paper. The patient, Mrs. L., was a primipara, well formed, healthy, and with no previous indication of a tendency to the frightful flooding from which she suffered after delivery. Her physician is Dr. Howard Gillespie Myers. He states that labor began at 9 P. M., on May 16th. The first stage was completed by midnight. Pains continued strong, and the baby was born at 2 A. M. Uterus contracted well, and in a half-hour, the placenta was expressed, by Credé's method, with ease. Bleeding was not unusual in amount thus far. A drachm of fluid extract of ergot was now given her. The doctor held the fundus uteri for some time. He remained at the patient's side, being anxious at the frequency of the pulse, which, from the birth, continued to be about 100. At 3:30 A. M. moderate hæmorrage began. Once more he took firm hold of the

uterus, finding it doughy and soft. Manipulation led to contraction—with a gush of blood; followed by relaxation again. Ice over the fundus proved useless. Next, two or three quarts of hot water douching, intra-unterine, were employed; followed by contraction, but only a temporary one again, after which the steady outpour of blood went on. Dr. Wm. D. Bell and Dr. Geo. W. Leonard were called in. Several hypodermatic injections of ergot were made. An intra-uterine application of a cotton pledget soaked in vinegar, was tried; result, same as before—a temporary contraction, then the continued free flow again. The foot of the bed was elevated, the extremities tightly bandaged to supply the brain and heart with more blood, and another hot intra-unterine douche was given, this time containing perchloride of iron. After this there was no further bleeding: Dr. Myers remarks that there could not well have been, as the patient seemed comp'etely exsanguinated. For some time before I was sent for and arrived, the patient had been unconscious, in muttering delirium, and the whole surface deathly cold.

When I saw her she looked moribund. Nothing at the first glance showed life save irregular gasping for breath, and the occasional delirious mutter. She was too weak to show restlessness. The skin was covered with cold sweat; the features pinched; the pupils dilated, the eyes looking glazed. Undoing the bandage on one extremity I found no pulse at the wrist, though the heart could faintly be heard beating very rapidly, and the finger just below Poupart's ligament could barely detect the artery. I do not think it likely that she could have lived an hour longer without saline infusion or else transfusion; and Dr. Myers shares this opinion.

As quickly as possible the normal salt-solution was prepared, *as hot as the hand could tolerate*. The hypodermatic needle was inserted in the right femoral artery just below Poupart's ligament. Feeble as she was, a thread of arterial blood came slowly up the needle. The catheter was attached, and pumping by the Davidson syringe began. A full pint of the hot salt-water was thrown slowly into the artery, taking nearly half an hour. The proof that it did enter the current, and was not deposited in the connective tissue about the vessel, is the fact that no swelling was produced. A pint, or even a quarter-pint, of water injected into the connective tissue spaces under the skin at any one place would produce a very prominent swelling.

During the operation the heat of the solution was maintained by keeping the vessel containing it in another of yet hotter water, to which boiling water was added as required.

Before this injection was half finished we were delighted to notice an evident improvement in the heart-action. By the end of the half-hour a faint pulse at the wrist was noticeable, and actually the delirium had ceased.

An interval of a half-hour was now allowed before further infusion: during which time she was kept well surrounded by hot applications (including a hot water-bag against the heart), received a hot beef-tea enema, and several small hypodermatic injections of strychnine sulphate and atropine sulphate, the former as a heart-tonic, the latter as a respiratory and sympathetic stimulant. Also one small injection of equal parts tincture of digitalis and tincture of strophanthus was used. Whiskey was freely introduced at many points by the needle.

At the end of this period she received a second full pint of the very hot normal salt-solution. Differing from the first pint, this was thrown into the connective tissue of the thighs, at some five or six different points. As fast as a moderately large swelling was produced, a fresh place was chosen, and one of the doctors briskly rubbed and diffused this tumor in a centripetal direction, and with vaselined hands. She was now conscious and complained of the pain caused by these manipulations.

Briefly, from this point she began to rally more rapidly, and in a few hours was out of danger so far as her circulation was concerned. But, for a number of days, Dr. Myers hardly left her bedside, as her stomach needed the most assiduous care; almost everything being rejected. Rectal alimentation supported her during this period. When able to retain food *per os* once more, she made a speedy recovery. Her summer was spent in the Adirondacks; and to-day she is strong and well.

My reason, in this case, for varying the technique while injecting the second pint (by using the subcutaneous cellular tissue instead of the artery), was that I thought the circulation then sufficiently strong to absorb the solution into itself: and I did not wish to pierce the artery needlessly. It would seem that if a patient requiring infusion was not in such extremely bad state as my case was at first, this latter method might do very well; but if a prompter and more certain effect be needed I should always prefer entering the artery with the needle.

At the time of operation upon this case I had never heard of saline infusion being employed by any other than the usual (that is, intravenous) method; with its

cumbersome accompaniment of venesection, tying in of a cannula, etc., etc. But shortly afterward I read in the "International Medical Annual" for 1891 a statement that subcutaneous injections of a normal salt-solution have been successfully used after post-partal hæmorrhage in the Dresden Lying-in Hospital. The technique is not given, either in the article, or its bibliography.

Of course, *transfusion*—of whipped blood, into the subcutaneous tissues—has long been known. Casse, of Belgium, in 1879 experimented by this plan. As lately as 1887, in Germany, H. von Ziemssen advocated it, using a large syringe and needle of abundant calibre, the patient being under chloroform meanwhile, and the blood being diffused by very vigorous rubbing.

But as has been elsewhere remarked, *blood*-injection for hæmorrhage, by this or any other plan, has now practically been dropped.

So far as the writer has been able to discover, the extremely simple and ready method of saline infusion herein described—that is, using an ordinary hypodermatic needle in an artery, etc.—has not heretofore been published; nor the suggestion of the value of a high temperature in the injected fluid, instead of that normal to the body.